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A PRELIMINARY REPORT ON RASPBERRY CURL OR YELLOWS *

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Raspberry curl, or "yellows," can probably be regarded as the most serious of raspberry diseases. This malady was first reported by Green in Minnesota (1894), and is apparently the same trouble as mentioned by Stewart and Eustace (1902), who called it "raspberry yellows." The writer believes that the original name, raspberry leaf curl, or raspberry curl, is descriptively more appropriate and lessens the possibilities of a misconception regarding its undetermined cause.

Although this malady has been known for some years, little work seems to have been done upon it. Green (1895), reported raspberry leaf curl as the worst raspberry disease in the state. Stewart and Eustace (1902), reported raspberry yellows as occurring in New York; they regarded it as distinct from raspberry cane blight caused by *Coniothyrium fuckelii* Sacc., (*Leptosphaeria coniothyrium* (Fckl.) Sacc., and the description of its field characteristics show it to be entirely different. Clinton (1903, p. 35), mentioned cane blight of raspberries, but from the symptoms given, namely, that "the foliage of the infected cane is usually streaked with yellow and crinkled," he appears to have been describing the raspberry curl disease, for the above symptoms are not characteristic of cane blight caused by *Leptosphaeria coniothyrium* (Fckl.) Sacc. Paddock (1914-5), stated that raspberry yellows attacked the Malboro in Colorado. Sackett (1910), merely mentions raspberry yellows, without giving any descrip-

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tion of its symptoms. In a later report (1911, p. 18), he speaks of spraying experiments in connection with "Project III Raspberry Yellows."

He does not clearly distinguish between raspberry "yellows" and raspberry cane blight. Interpretation of his results indicates that spraying with Bordeaux mixture controlled both diseases—a conclusion which is not in accord with the writer's experience with raspberry curl.



Fig. 1. Plants affected with raspberry curl showing the stunted growth and bushy appearance.

Lawrence (1911), assigns various factors as a possible cause of raspberry yellows, among them fungi, poor grainage, lack of soil fertility etc. A "bacterial disease" of raspberries was reported by Detmers (1891) in Ohio. From the description of the disease, the malady is undoubtedly the one under discussion.

The name "raspberry yellows" has been and is used indiscriminately to cover a multitude of symptoms. In some instances in which people have heard that there is such a disease as "raspberry yellows," a case definitely diagnosed as such, because a few yellow leaves happen to be present. The true raspberry curl, or "yellows", has very definite, striking, characteristic symptoms and should not be confused with unthriftiness of plants due to cultural conditions nor to a drying or blighting of the leaves and canes as brought about by raspberry cane blight.

Occurrence of Raspberry Curl. Raspberry curl is found mainly on Cuthbert, Marlboro, Golden Queen, Early King and Herbert, the varieties being susceptible in the order named. Cuthbert and Marlboro are probably the most susceptible varieties, and at present are being discarded entirely for commercial purposes. The disease is found occasionally in other varieties of red raspberries, but very rarely on black caps or purple kinds.

Besides occurring in Minnesota and New York, it has been reported in Connecticut and Colorado. The writer has found this disease in Ohio, Michigan, California, and Washington, and it is probable that this same trouble occurs in Canada, Massachusetts, Pennsylvania, and Kansas, while not improbable that it could be found in most localities where the red raspberry is grown extensively.



Fig 2. Current year's growth showing premature flowering.

Economic Importance. The writer has made a study of raspberry curl in Ohio, especially in Lucas and Cuyahoga counties, two localities which have grown raspberries extensively. In these regions red raspberries were at one time a very important crop. Today there is grown only one-fifth the acreage of eight years ago. This falling off has been due, as far as can be ascertained, entirely to the raspberry curl disease. A number of growers conservatively estimate an annual loss of \$200 per acre due to this disease.

Symptoms of Raspberry Curl. Generally the disease does not make its appearance until the second year after planting, while sometimes three season elapse before it becomes severe enough to attract attention. When it once appears in a plant, it invariably reappears annually to a greater or less extent and as long as

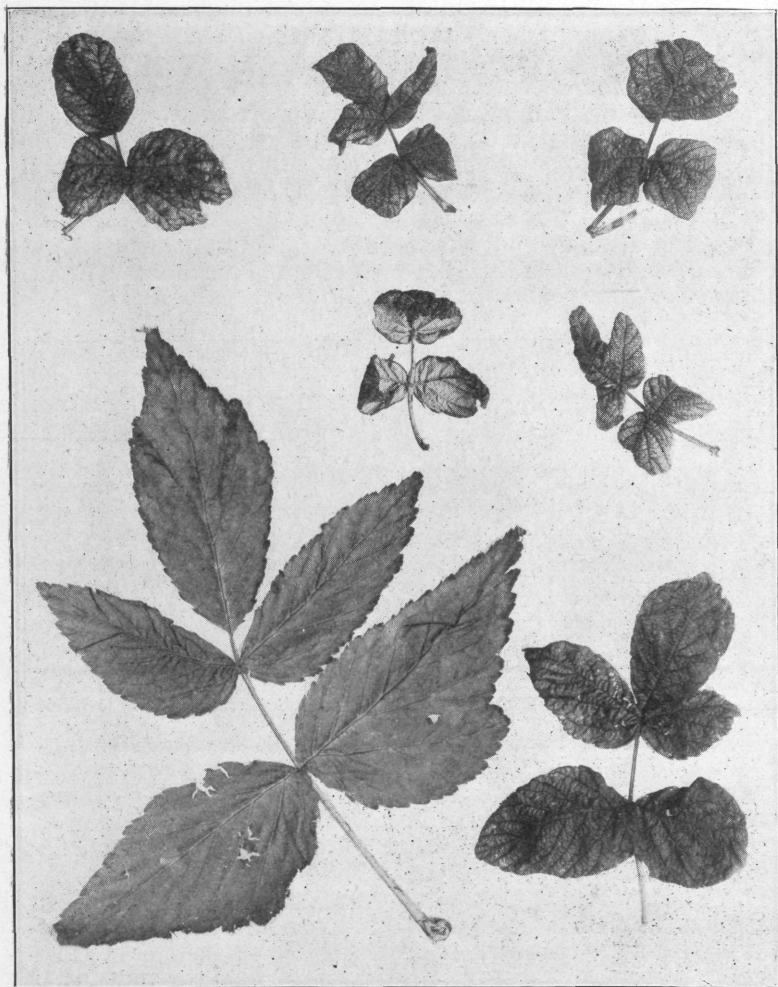


Fig. 3. Showing comparative size of healthy and diseased leaves, also the sunken vascular system and the arching upward of the intervenal tissues.

that plant happens to live. According to some of the older growers in Lucas county, raspberry plants twelve years old are said to have produced this "curly foliage" annually for nine years.

One of the more striking symptoms of this disease is the stunted or dwarfed appearance of the plant. See fig. 1, compare with fig. 5. A withering or blighting of the canes or leaves never occurs in the case of this disease. There are no indications of a lack of turgescence in any of the tissues of an affected plant.

The canes are short, and when the fruiting laterals are formed the plant has a compact, bushy appearance. The internodes both in the canes and in the laterals are very short. We may have

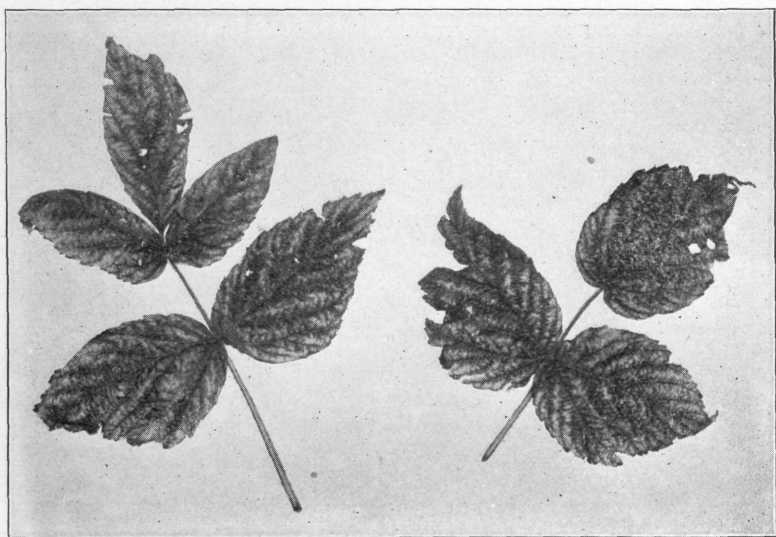


Fig. 4. Mottled effect of the leaves of raspberry curl.

apparently healthy and diseased canes arising from the same crown. Premature flowering of the current years' growth is not uncommon, terminal inflorescence being frequently present, as shown in fig. 2. Diseased sprouts emerge from the soil with a sickly, pale yellowish-green color, the leaflets being small and more or less curled. The writer has observed such sprouts arising at a distance of *three feet* from the parent crown. As these canes grow older, the leaflets become darker green and noticeably revolutely curled. See fig. 3.

The most striking characteristic of the diseased leaflet blade, is the arching upward of the intervenal tissues, which cause the vascular system to appear sunken. See fig. 3. It is this

uneven expansion of tissues which brings about the revolutely curled condition of the diseased foliage. During the summer months the foliage may acquire a mottled appearance, at first a light yellow, gradually changing to darker shades of green and yellow and eventually transforming into a reddish-bronze hue. See fig. 4. The severity of curl and variations and intensities of color depend very greatly upon soil and climatic conditions. An abundance of rain is unfavorable to the development of the above symptoms, while hot and dry weather produce the more conspicuous cases. All diseased foliage, besides being curled and mottled, is considerably smaller and never attains its natural size. See fig. 3. In September or October it is not uncommon to find



Fig. 5. Two-year-old healthy Cuthbert raspberry plants.

considerable mottled foliage; the spots may vary from a yellowish tinge to a bronze, in many cases not unlike mosaic disease in their color, size, shape and location with reference to the vascular system. See fig. 4.

The berries mature from ten days to two weeks earlier than the normal crop. They are small, often deformed, lighter in color than the normal berry, and when apparently ripe are bitter, later becoming insipid. If allowed to remain on the cane until they become "dead ripe", they acquire a slight flavor, which is, however, far from pleasant. In fact the berries are so small and poor in quality that berry pickers refuse to pick at the customary price per quart and commission men will not handle the fruit on account of its inferior qualities.

From general appearances, the root system of diseased plants seems normal. This disease is peculiar in that we may have diseased and healthy plants of the same or different varieties growing side by side. This has often been observed by the writer where Cuthbert and Early King were growing in the same row, the former variety always being the more susceptible. It is also of interest to note that raspberry curl may make its appearance in a plot even though cane blight has never been known to occur among such plants. The writer has likewise noticed that although cane blight may be very severe in a patch of berries, a careful search did not reveal the presence of a single case of raspberry curl.

Cause of Raspberry Curl. As yet no definite cause can be assigned to this disease. Stewart and Eustace (1902), intimated that it might be related to the so-called physiological diseases, such as, peach yellows, while others are attacking this problem with the expectation of locating a pathogen. Paddock (1904-5), noticed that the disease was more pronounced where plants were growing in a soil which had a high water table. This in part agrees with the observations made by the writer, particularly where plants were growing in a heavy soil. It was thought at one time that insects might be contributing factors toward the production of these curled leaves. The opinions of entomologists which the writer has at hand, however, do not substantiate this.

The writer has made numerous attempts at isolating a causal organism, selecting different parts of diseased tissue of various ages, but up to the present time no organism has been obtained which has been conclusively shown to be the cause of this disease. Old crowns frequently contain various fungi, but their connection with the appearance and production of raspberry curl, in the writer's opinion, is problematical. An attempt was made to correlate this disease with the occurrence of crown gall on raspberry plants, but of the hundreds of plants examined, no relationship was found to exist.

At present the writer is making a histological study of diseased tissues. So far, he has been unable to locate bacteria or fungi in typical specimens which have been examined. This, however, is not to be interpreted as meaning that a pathogen does not exist in the diseased tissues of the raspberry plant. Inability to discover an organism up to this time may be due to various factors, such as the size of the organism concerned or the difficulty in properly staining and differentiating the very fine mycelia within the host tissue. Further studies are being made along this line, and a more detailed report will be published later.

The writer has had occasion to observe that heavy, compact soils, lacking proper drainage, are more liable to have plants affected with raspberry curl, than lighter soils which are ade-

quately drained and aerated. During rainy seasons we apparently have less of this disease than during hot and dry weather. Indications are that the soil fertility question is not directly involved.

Recommendations. In planting red raspberries, secure plants from localities where raspberry curl does not occur. Grow varieties which do best in your locality and which seem adapted to your soil conditions. St. Regis seems to be a promising variety not so susceptible to this disease. Early King and Herbert are standard varieties doing well in some localities. The former is the only red variety which can be economically grown in Lucas county, Ohio, and is entirely replacing all other varieties.

Plant on a rather light or medium heavy soil which is provided with adequate drainage. The addition of barnyard manure well incorporated into the soil is of value in producing vigorous and thrifty plants. Where irrigation is possible, it is highly beneficial and is advisable, especially during adverse seasons.

Plants affected with raspberry curl are best removed and destroyed, as they are worthless for the production of marketable fruit. Never use disease plants for propagation purposes.

The application of fungicides is useless in controlling raspberry curl.

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